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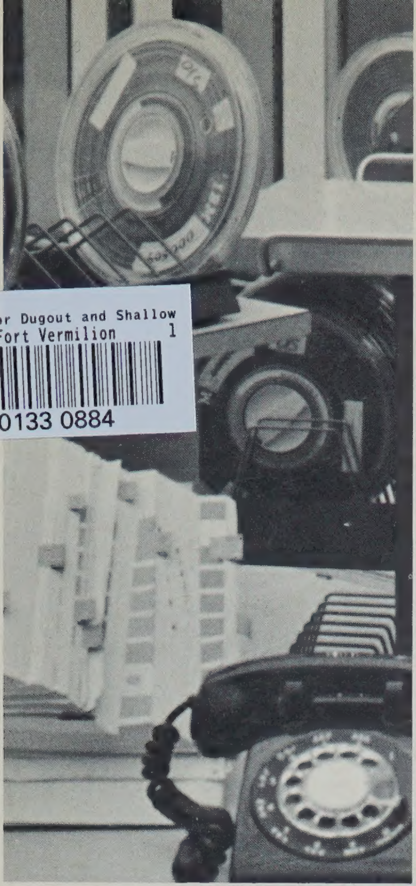

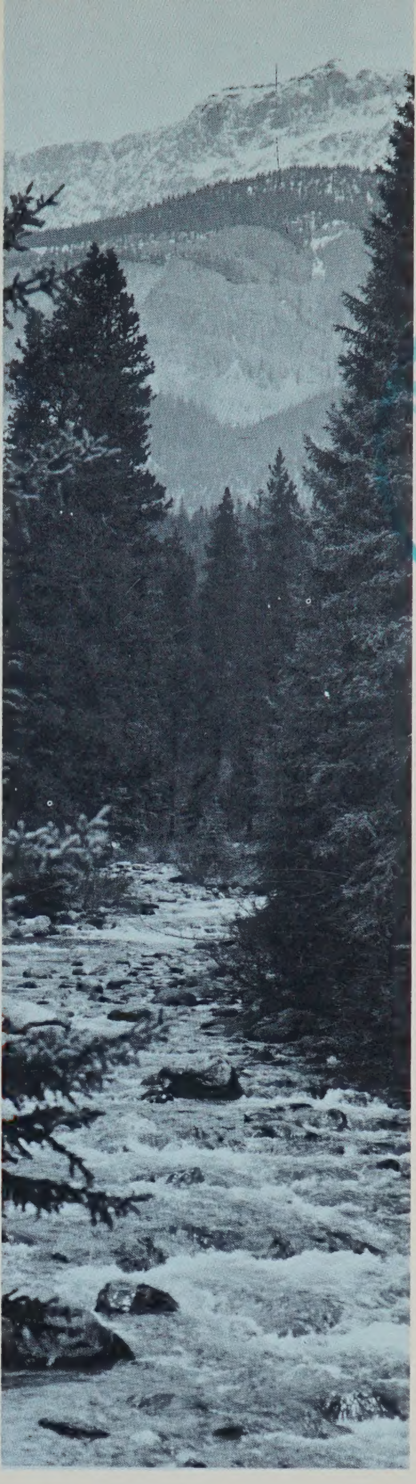

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A Feasibility Study for Dugout And Shallow Well Sites in The Fort Vermilion - LaCrete Region

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A Feasibility Study for Dugout
And Shallow Well Sites in The
Fort Vermilion - LaCrete Region

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Water Resources Division

Soils, Geology and Groundwater Branch

Alberta Department of Agriculture

A Feasibility Study For Dugout And Shallow Well Sites In The Fort Vermilion - LaCrete Region

Prepared By
Groundwater Section

Edmonton, Alberta

Dec., 1970

Submitted by:
H.A. Kerr
Head
Groundwater Section

ACKNOWLEDGEMENTS

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M. Rudakewich - District Agriculturist of Fort Vermilion

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Mrs. E. Ferguson
E. Spofford
M. Bennett
J. Bowley

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INTRODUCTION

This study was initiated in order to compile all the available data concerning the surface and subsurface soils of the Fort Vermilion-LaCrete region. This information had been used in the past to make tentative predictions regarding the feasibility of dugout and shallow well construction in the region.

Furthermore, it was hoped to prove or disprove the hypothesis, that in a repetitious manner, fine textured soils occurred on the upslope region and coarse textured soils on the downslope region of knolls. If this would be the case, spring runoff water, temporarily collected in the swales could be stored permanently in the dugouts constructed in the fine textured material upslope.

AREA, SOILS AND GEOLOGY

The study pertains to the area near the towns of LaCrete and Fort Vermilion; a total of approximately 300,000 acres. The majority of the population is centered along the main access roads leading to the two towns. The topography of the area varies from level to slightly undulating in the south eastern sections, to fairly hilly in the areas closer to the Peace River.

Soils adjacent to the Peace River are classified according to the National Soil Survey Committee of Canada as undifferentiated. In the area between one and fifteen miles south-east of the Peace River, Dark Grey Wooded and Grey Wooded soils, in association with Eluviated Gleysols and Organic soils prevail. Beyond a distance of 15 miles south-east of the Peace River, Organic soils along with Gleysols predominate.

The Fort Vermilion-LaCrete Region is mainly overlain by alluvial sandy material along the river, lacustrine silty deposits in the central region and peaty material in the southeastern portion of the map area. The band of alluvial material is approximately 4 miles wide, except near the towns of Fort Vermilion and LaCrete where it extends from the river for 7 miles in a southern and eastern direction, respectively. The alluvial material west of LaCrete has been reworked through wind action. Areas of till are present in a scattered fashion around Buffalo Head, extending especially in a southern direction.

The overlying surficial deposits vary from 40 feet thick in the southern part to 130 feet thick in the northern part of the study area. Near the river a clayey coarse gravel underlies the alluvial deposits. Underlying the entire region is the Lower Cretaceous Spirit River Formation, consisting of a marine shale.

RESULTS AND DISCUSSION

The study region has been extensively drilled in our investigations of dugout and shallow groundwater sites. Seventy holes have been drilled from 1966 to date with inadequate results in most cases. Figure 1 shows the upper 20 feet of all the holes in the area. The study of material on the upslope versus downslope portions of knolls is given in Figure 2 with the results of the shallow groundwater drilling in Figure 3.

Figure 1 indicates that fine textured soils, which are highly desirable for dugout construction, are absent in the region except for an extensive clay-loam till area around Buffalo Head and a small area of pink colored till 5 miles northeast of Fort Vermilion. A doubtful area with a silty clay-loam - silty clay soil is present 10 miles northeast of LaCrete. However, because of its laminated nature, the soil is an unreliable dugout material. Moreover the prevalent high water tables in the Fort Vermilion-LaCrete region result in a back pressure which, in due time, will cause the banks of the dugouts to slump inwards.

Figure 2 indicates that fine textured soils are generally absent in obth the upslope and downslope portions of the knolls studied. Sandy materials, 5 to 20 feet thick, overlie the silt deposits. Near the towns of Fort Vermilion and LaCrete, these sand deposits extend to a depth of approximately 5 feet, but increase to depths of over 20 feet in the region between these two towns. In general sandy deposits are more

abundant on the upslope region than the downslope region of the knolls, because of the aeolian nature of these knolls. In conclusion it can be stated that the locations of the heavy textured soils are more related to the geographic, than to the topographic position in the landscape.

Figure 3 indicates the profiles obtained from the various water-well site investigations. The best water, both in quantity and quality, generally is found in the thick alluvial deposits and their underlying clayey coarse gravels, near the Peace River. Possibly, small supplies could be obtained in the area southeast of LaCrete, through culvert collecting from seepage water. In the remainder of the Fort Vermilion-LaCrete Region, the possibility for an adequate supply of well water is remote. Chemical analysis of water from shallow wells, indicate a strong salinization of the water, especially by Na_2SO_4 and $CaCO_3$ salts.

CONCLUSIONS AND RECOMMENDATIONS

The general lack of well water in the Fort Vermilion-LaCrete region necessitates dugout construction, regardless of the fact that the soil material is unfit. To improve the water holding ability of the dugouts, lining with plastics or clays, or treatment with chemicals are possible solutions. However, the costs of the lining methods are beyond the means of the average farmer.

A few separate studies concerning bentonite lining, were set up under the auspices and with the financial help of the government. The tests were initiated only recently and therefore, positive conclusions cannot be drawn as yet. The soils in this region, with a low percent clay (20%) and a low exchange capacity (30 me/100g) are generally considered to be unsuitable for treatment with Sodium Carbonate. However, the above data, constitute a border case, and as such more detailed analysis, especially clay mineralogy analysis would be advisable. Furthermore, laboratory tests of the effects of the various chemicals available to reduce water movement through soils, are recommended on this particular soil.

APPENDIX

BEDROCK EXPLORATION RESULTS

Six holes, into bedrock, were drilled in order to determine the possibility of obtaining water from the bedrock. No aquifers were found with the bedrock being predominately shale and siltstone over limestone at a depth of over 300 feet. The limestone (elevation approximately 600 feet above sea level) which is known to contain natural gas, was the base of our operations. We had considerable trouble and expense in containing the gas encountered at hole 113E. Great care should be exercised if drilling is planned into the limestone.

In general, groundwater will not be encountered in the bedrock but may be found in surficial deposits of sand and gravel. This coarse material often occurs on the bedrock surface especially around the Peace River.

FIELD LOG HOLE 111E Estimated Elevation 915'

0 - 5	silty loam
5 - 40	silt 5Y5/1
40 - 48	LFS brown
48 - 65	LMS
65 - 91½	silt, 5Y5/1
91½ - 92	gravel
92 - 95	pink silty clay
95 - 145	silty clay, 5Y4/1
145 - 170	5Y 4/1 siltstone with hard shale at 162½-163½, 165-166. 169½-170
170 - 240	5Y 4/1 hard siltstone with hard shale at 181-181½, 198 -198½
240 - 242	hard shale
242 - 252	5Y 4/1 medium siltstone
252 - 252½	hard shale
252½ - 255	hard sandy shale, dark greenish grey
255 - 267½	5Y 4/1 soft siltstone
267½ - 268½	hard shale, dark greenish grey
268½ - 271	medium siltstone dark greenish grey
271 - 272½	5Y 4/1 hard sandstone
272½ - 288	5Y 4/1 soft siltstone
288 - 289	hard shale
289 - 314½	med. siltstone with hard sandy shale at 307 - 308
314½ - 315	med. sandy shale
315 - 319½	hard siltstone
319½ - 320	T.D. hard limestone

FIELD LOG HOLE 112E Estimated elevation 950'

0 - 15	5Y 5/3 silt
15 - 100	5Y 5/1 silt. A few stones (gravel) at 94-95
100 - 107	5Y 5/1 silty clay
107 - 170	5Y 4/1 siltstone with soft siltstone at 111-119 med. siltstone at 119½ - 129 hard shale at 107-108, 110-111, 129-129½, 153½-154, 169½-170 very hard shale at 119-119½, 147-148, 161½-162 hard sandy shale at 132-133 and at 162½ to 166 is hard shale with soft layers, 5Y 4/1 to brown
170 - 292	5Y 5/1 siltstone with hard shale at 175-175½, 188-189½, 197-197½ 220-220½, 223-223½, 228-228½, 239-239½, 243-243½, 280-281, and hard sandy shale at 291-292.
292-347½	5Y 4/1 siltstone with hard siltstone at 325-328 5Y 4/1 to greenish hard siltstone at 329-334 med. sandstone at 302 - 304 siltstone with s.s. lenses at 315-320 soft sandstone at 328-329 hard shale at 307 - 307½, 324-325 very hard shale at 334-335
347½ - 352 (350' E-log)	T.D. Hard white limestone

FIELD LOG HOLE 113E Estimated Elevation 975'

0 - 10	5Y 5/3 silt
10 - 15	5Y 5/2 silt
15 - 20	5Y 5/1 silt
20 - 60	5Y 5/1 silty clay loam
60 - 65	pink clay loam with pebbles to 1/16" diam.
65 - 66	gravel
66 - 210	5Y 5/1 siltstone with: Hard shale at 73-74, 77-78, 86-86½ 91-92½, 104½-105½, 120-121, 159-159½, 166½-167, 167½-168, 172½-179, 195-195½, 209-210 very hard shale at 152-153 hard sandy shale at 149-150 hard sandstone at 151-152 very hard shale with brown staining at 141½-142½
210 - 350	5Y 4/1 siltstone with: hard sandstone at 333-335 hard sandy shale at 312-312½, 319-319½ hard shale at 214-215, 237½-238, 244-245, 248½-249 254-255, 257½-258, 267½-268, 277-277½, 282½-283, 309-309½
350 - 365	5Y 4/1 soft siltstone with some very fine sand
365 - 380	sandstone 5Y 4/1 (greenish) very fine grained
380 - 381	Hard limestone
T.D.	

NOTE: Natural gas was encountered in the limestone

FIELD LOG HOLE 114E

0 - 7½	5Y 5/3 silty loam
7½ - 15	5Y 5/3 silt
15 - 20	5Y 5/1 silt
20 - 92	5Y 5/1 silty clay loam
92 - 95	boulders and gravel
95 - 101	fine gravel
101 - 428	5Y 5/1 siltstone with 5Y 4/1 siltstone at 120-129
	siltstone (color unspecified) at 101-102½, 375½-377½, 378-382 383-399, 400-420
	shale at 103-105
	med. siltstone at 106-110
	hard shale at 102¼-103, 105-106, 119-120 (5Y6/1) 129-130 (5Y5/1) 169-169½ (5Y5/1 to brownish) 212½-213½ 222½-223, 225-225½, 245-247, 265-266, 269½-270 274½-275, 286½-287, 290½-291, 300-300½, 310-311, 315-315½, 321-322, 344-344½, 356-356½, 361-361½, 366½-367
	siltstone with thin layers of hard shale 230-245
	dark green siltstone and sandy shale 367-373
	hard sandstone, greenish at 373-375½
	hard sandstone at 377½-378, 382-388½
	hard sandstone or shale at 399-400, 421-422
428-429 (T.D.) 428-E-log)	hard limestone

FIELD LOG HOLE 115-E

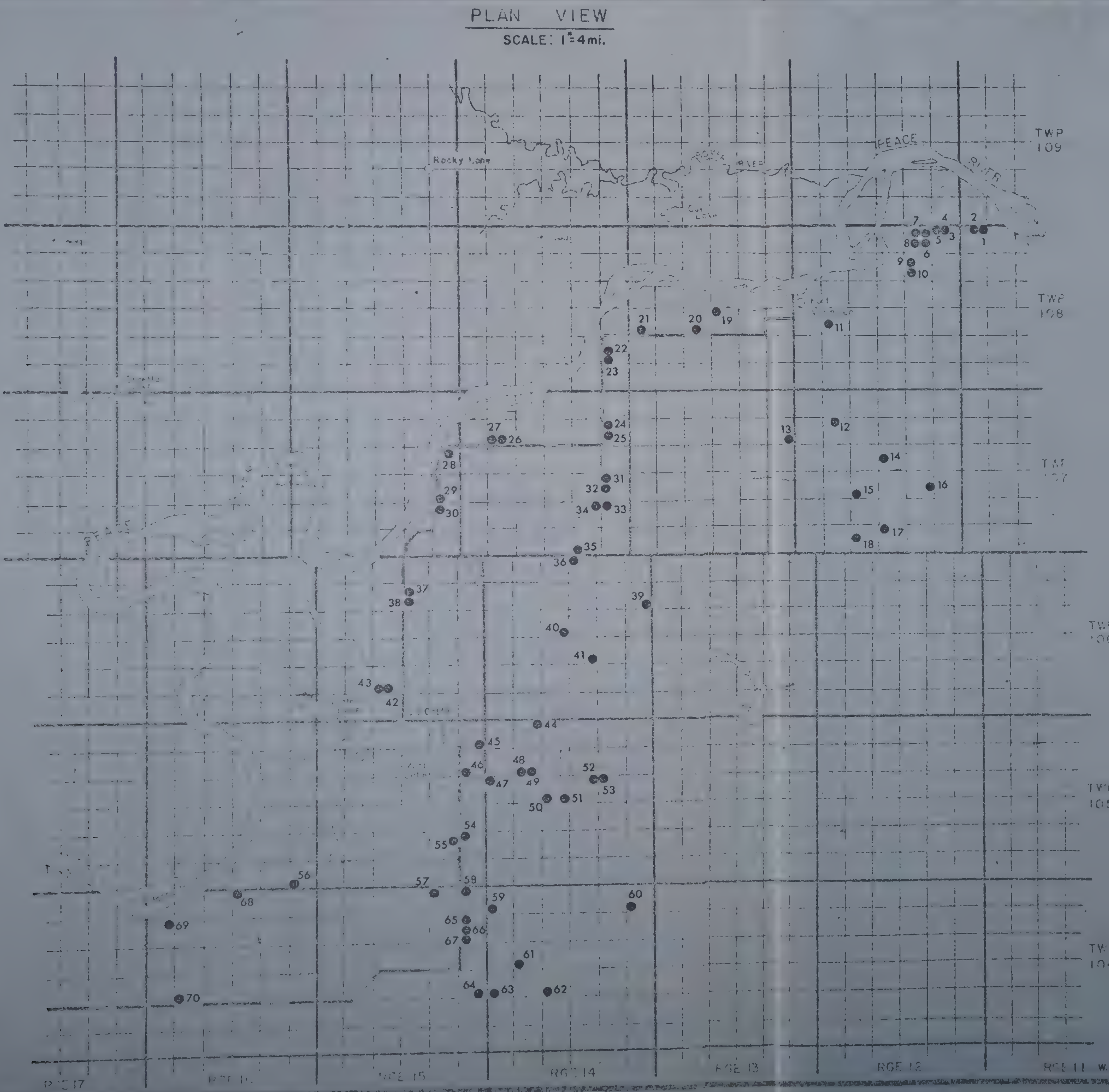
0 - 2½	5Y 5/3 loam
2½ - 35	silty clay loam
35 - 48½	silty clay loam with O.M.
48½ - 64	Fine gravel and sand (takes water)
64 - 67	fine gravel
67 - 72½	silt
72½- 90	fine gravel and sand
90 - 92½	gravel
92½ - 97	5Y 5/1 clay (till)
97 - 105	gravel with clay
105 - 112½	graveland grey clay mixed
112½- 157½	5Y 5/1 sandy clay (till)
157½ -175	gravel
175 - 188	5Y5/1 sandy clay (till)
188 - 188½	boulder
188½- 191	gravel
191 - 210	5Y 4/1 siltstone with hard shale (?) at 207-207½
T.D.	

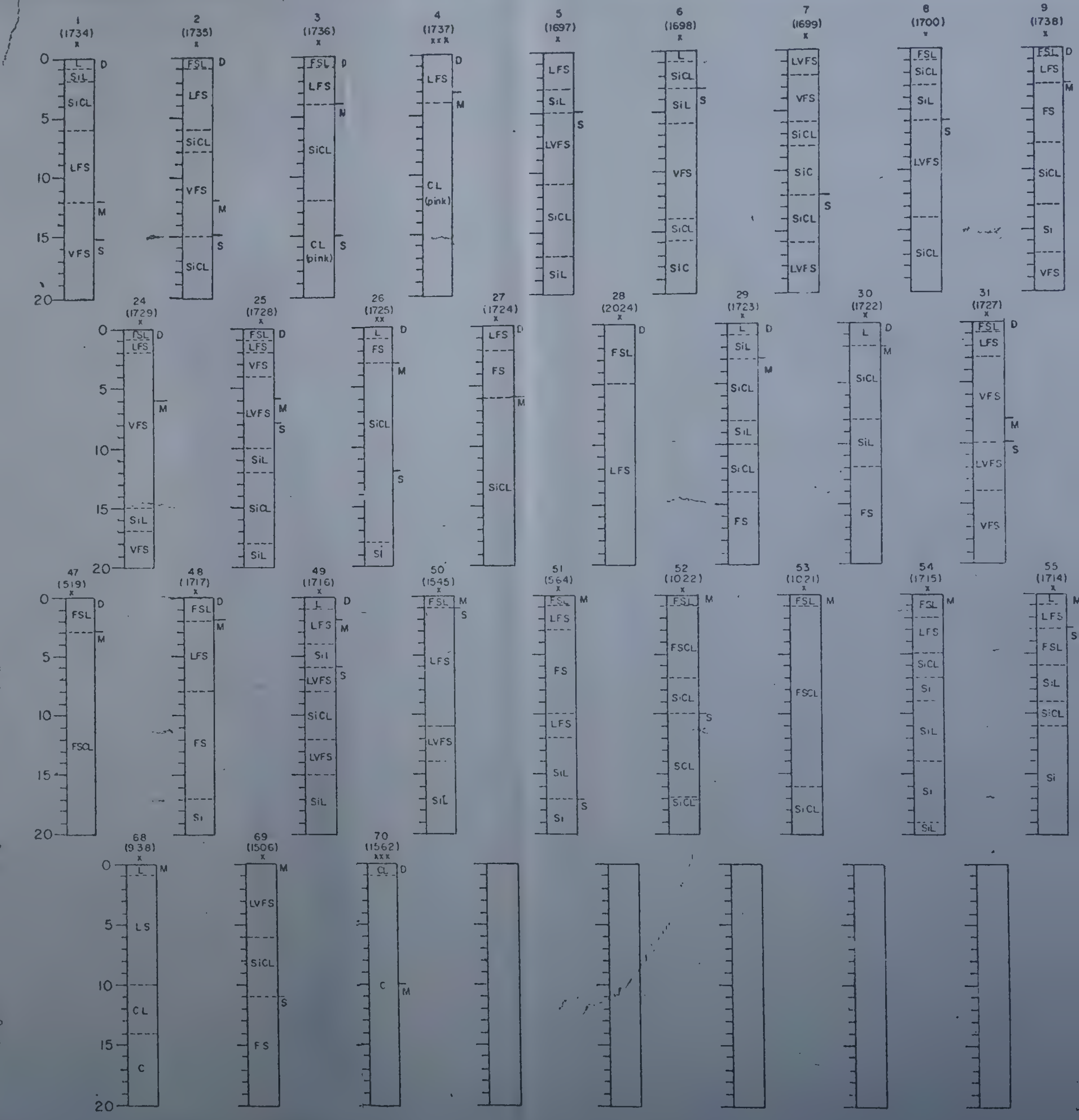
FIELD LOG HOLE 116E

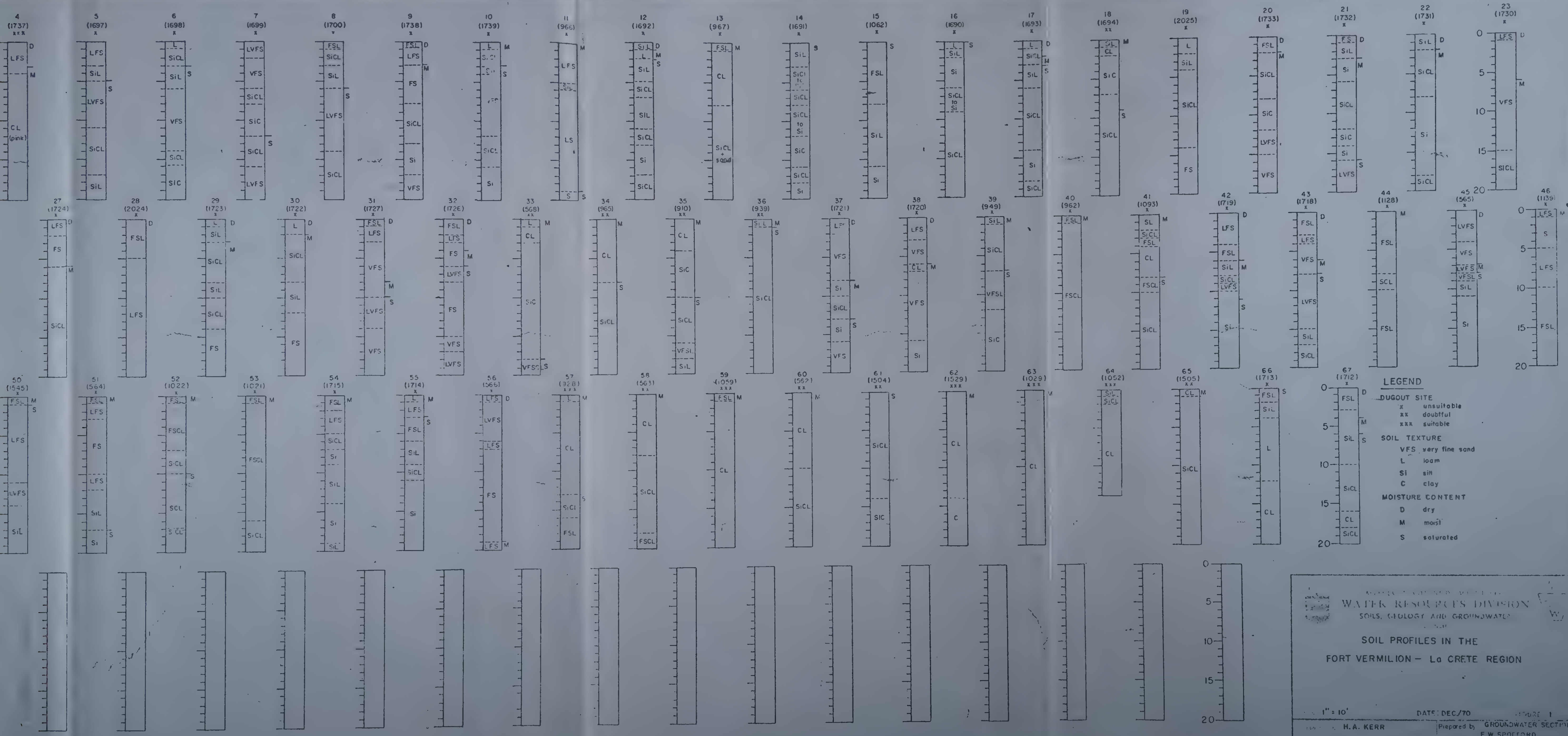
0 - 2½	clayey sandy loam
2½ - 29	gravel
29 - 33	loamy clayey sand
33 - 48	gravel
48 - 80	till? with gravel and boulders
T.D.	Gravel caved
	Unable to go deeper or to E-log

PLAN VIEW

SCALE: 1"=4mi.







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SOILS, GEOLOGY AND GROUNDWATER

SOIL PROFILES IN THE
FORT VERMILION – La CRETE REGION

1" = 10'
DATE: DEC./70
FIGURE 1

H.A. KERR
L.D.M. SADLER

Prepared by GROUNDWATER SECTION
E.W. SPOFFORD
H. VANDER-PLUYM

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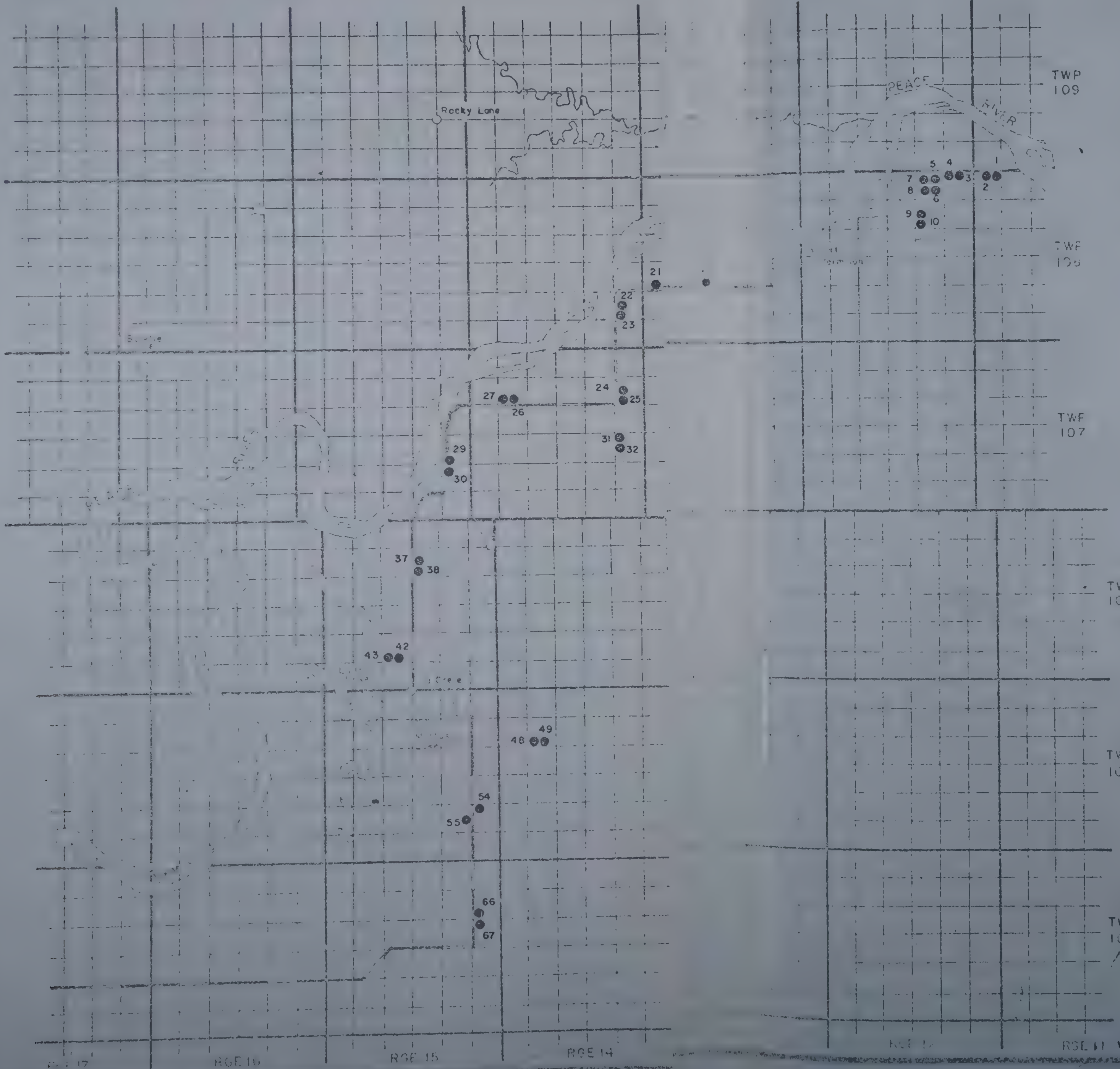
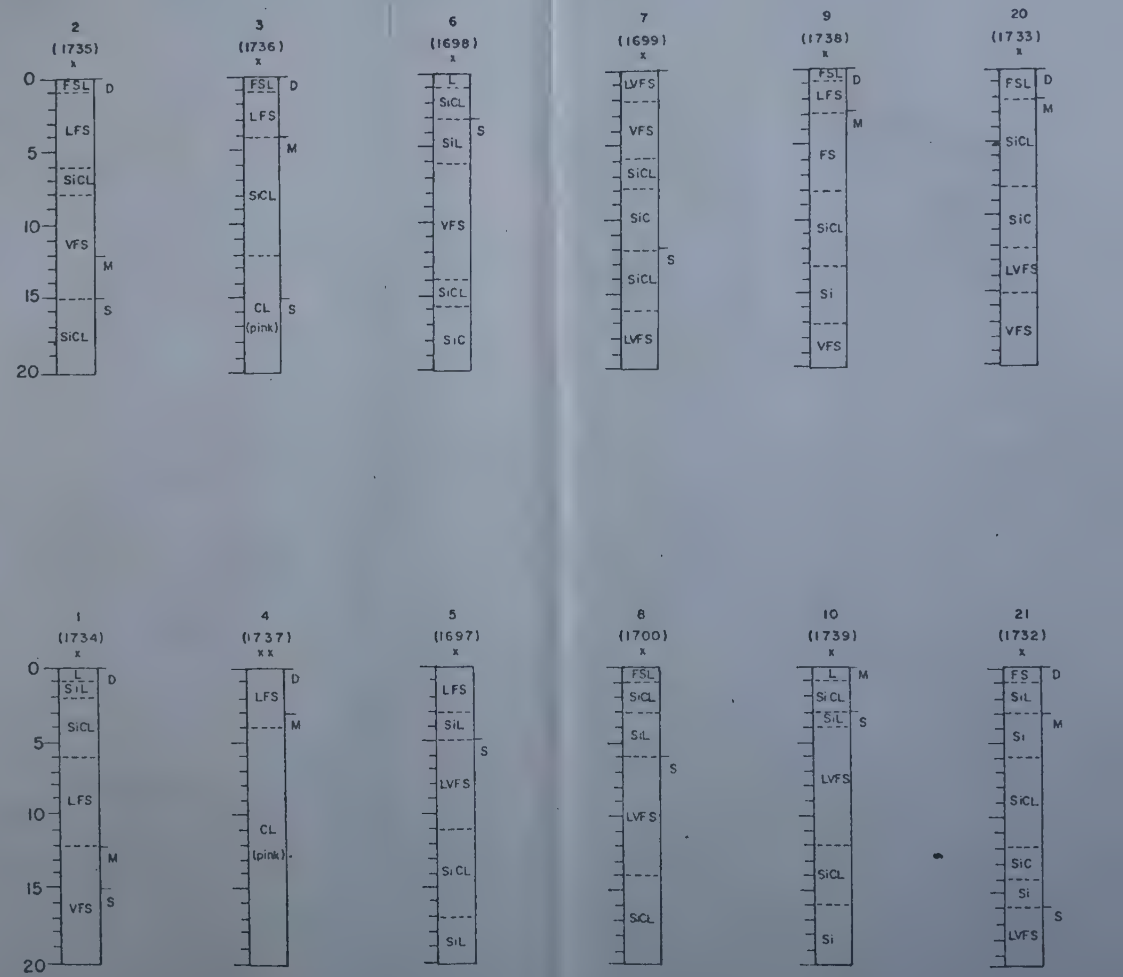
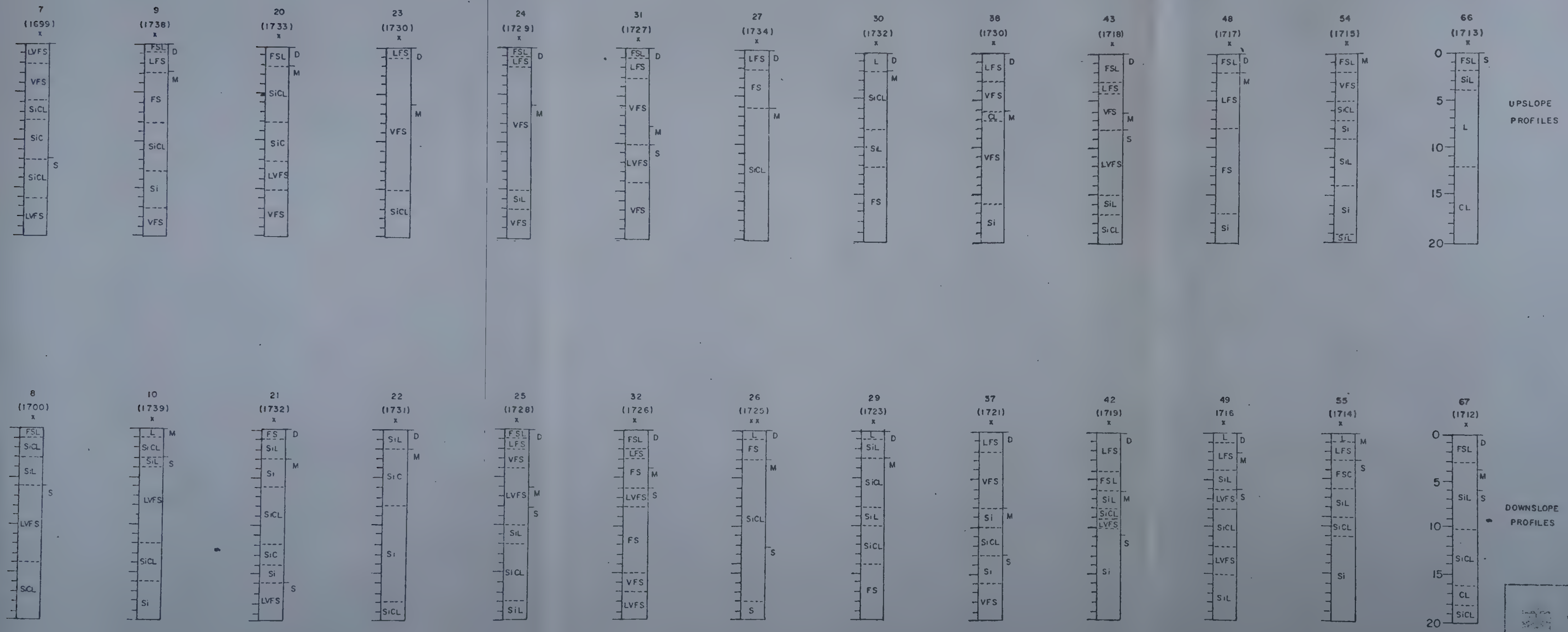
PLAN VIEW

SCALE 1"= 4mi.



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9 (1738) x FSL LFS FS SiCL Si VFS D M
20 (1733) x FSL SiCL SiC LVFS VFS D M
23 (1730) x LFS VFS SiCL D M
24 (1729) x FSL LFS VFS SiL VFS D M
31 (1727) x FSL LFS VFS LVFS VFS D M S
27 (1734) x LFS FS SiCL D M
30 (1732) x L SiCL SiL FS D M
38 (1730) x LFS VFS CL VFS Si D M
43 (1718) x FSL LFS VFS LVFS SiL SiCL D M S
48 (1717) x FSL LFS FS Si D M
54 (1715) x FSL VFS SiCL Si SiL Si SiL M
66 (1713) x FSL SiL L CL S
0
5
10
15
20
UPSLOPE PROFILES
8 (1700) x FSL SiCL SiL LVFS SiCL S
10 (1739) x L SiCL SiL LVFS SiCL Si M S
21 (1732) x FS SiL Si SiCL SiC Si LVFS D M S
22 (1731) x SiL SiC Si SiCL D M
25 (1728) x FSL LFS VFS LVFS SiL SiCL SiL D M S
32 (1726) x FSL LFS FS LVFS FS VFS LVFS D M S
26 (1725) xx L FS SiCL S D M S
29 (1723) x L SiL SiCL SiL SiCL FS D M
37 (1721) x LFS VFS Si SiCL Si VFS D M S
42 (1719) x LFS FSL SiL SiCL LVFS Si D M S
49 1716 x L LFS SiL LVFS SiCL LVFS SiL D M S
55 (1714) x L LFS FSC SiL SiCL Si M S
67 (1712) x FSL SiL SiCL CL SiCL D M S
0
5
10
15
20
DOWNSLOPE PROFILES

LEGEND

DUGOUT SITE

x	unsuitable
xx	doubtful
xxx	suitable

SOIL TEXTURE

VFS	very fine sand
L	loam
Si	silt
C	clay

MOISTURE CONTENT

D	dry
M	moist
S	saturated

WATER RESOURCES DIVISION
SOILS, GEOLOGY AND GROUNDWATER

DUGOUT SITES IN THE UPSLOPE, DOWNSLOPE REGION OF KNOLLS IN THE FORT VERMILION La CRETE REGION

1" = 10'
DEC./70
FIGURE 2

H.A. KERR
L.D.M. SADLER
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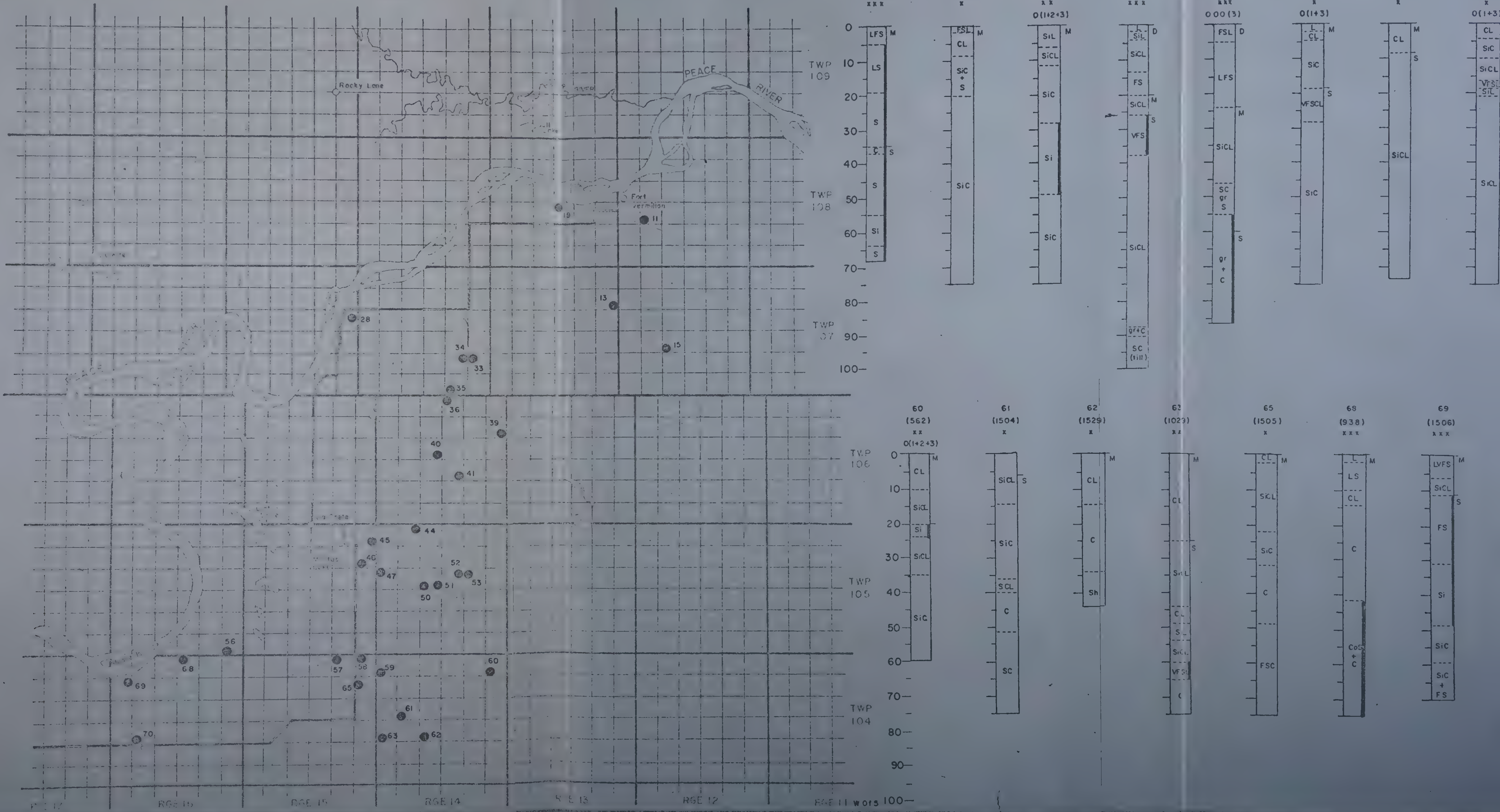
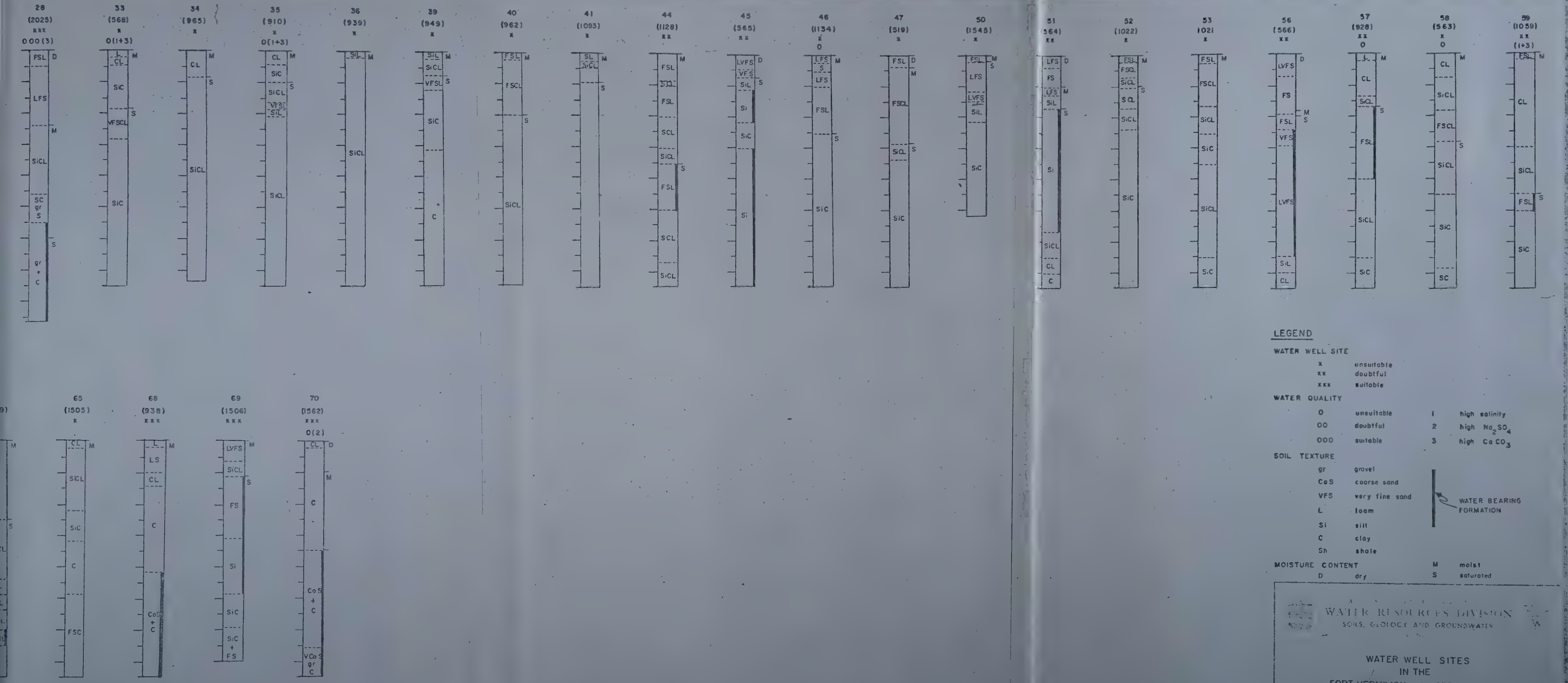
H. VANDER-PLUYM
9-L-610A-AB-2

PLAN VIEW

SCALE 1" = 4 mi.





LEGEND

WATER WELL SITE

x	unsuitable
xx	doubtful
xxx	suitable

WATER QUALITY

0	unsuitable	1	high salinity
00	doubtful	2	high Na_2SO_4
000	suitable	3	high $CaCO_3$

SOIL TEXTURE

gr	gravel
CoS	coarse sand
VFS	very fine sand
L	loam
Si	silt
C	clay
Sh	shale

WATER BEARING FORMATION

MOISTURE CONTENT

D	dry	M	moist
		S	saturated

WATER RESOURCES DIVISION
SOILS, GEOLOGY AND GROUNDWATER

WATER WELL SITES
IN THE
FORT VERMILION - La CRETE REGION

Scale. 1" = 20 Date DEC/70 FIGURE 3

H.A. KERR
L.D.M. SADLER

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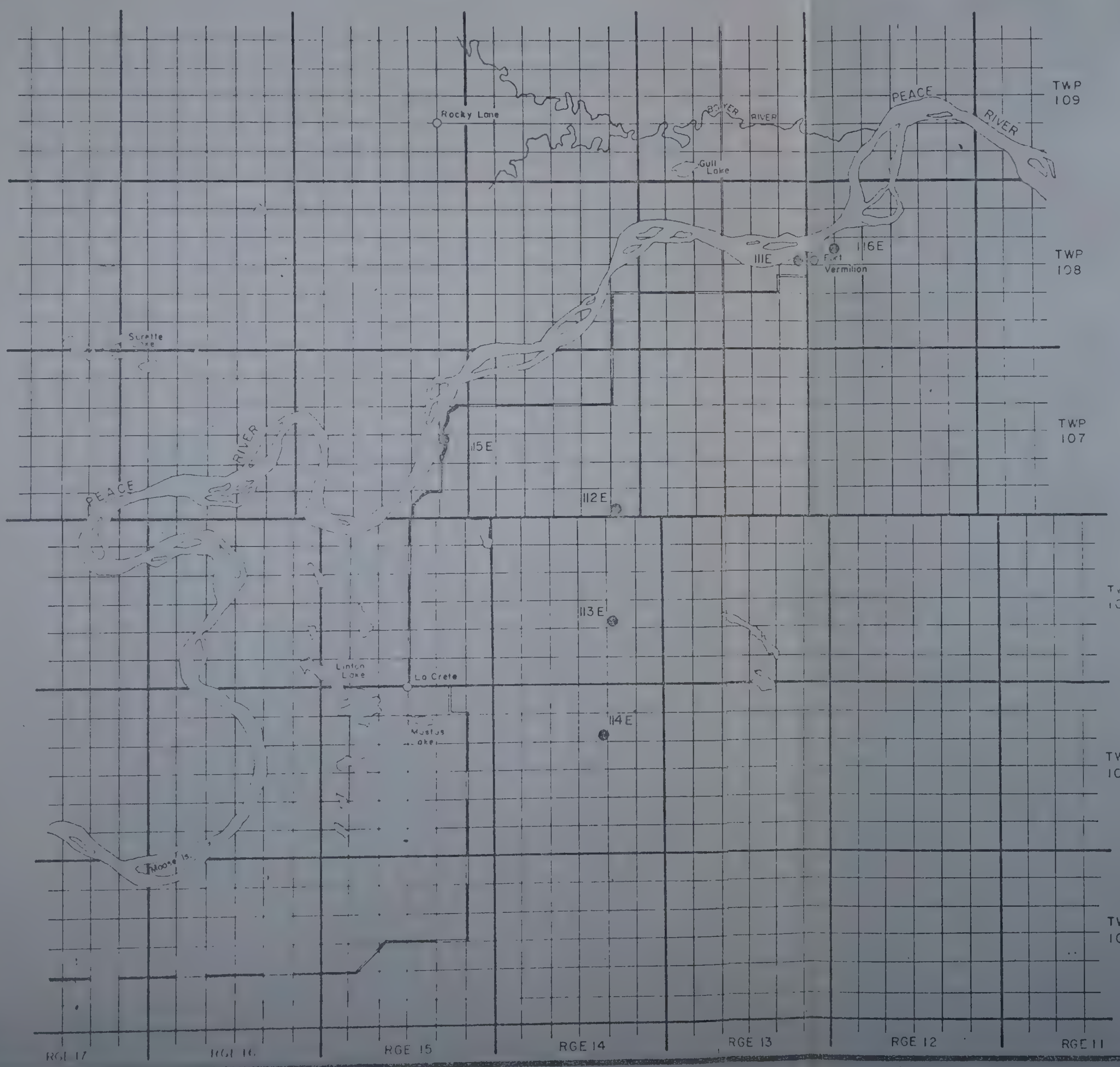
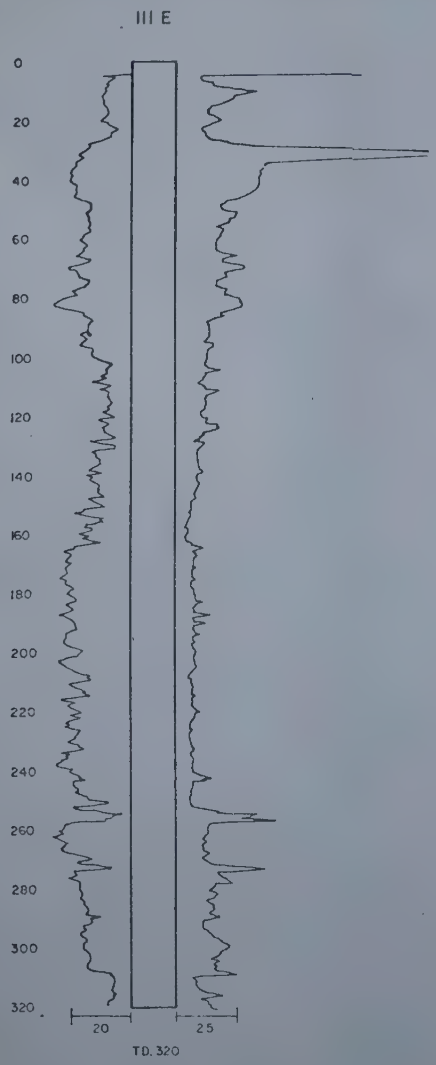
9-L-610A-AB-3

PLAN VIEW


Rocky Lane
BOYER RIVER
Gull Lake
PEACE RIVER
TWP 109
TWP 108
TWP 107
TWP 106
TWP 105
TWP 104
111E
116E
Fort Vermilion
Surette Lake
PEACE RIVER
115E
112E
113E
Linton Lake
La Crete
Mustus Lake
114E
Moose Is.
RGE 17
RGE 16
RGE 15
RGE 14
RGE 13
RGE 12
RGE 11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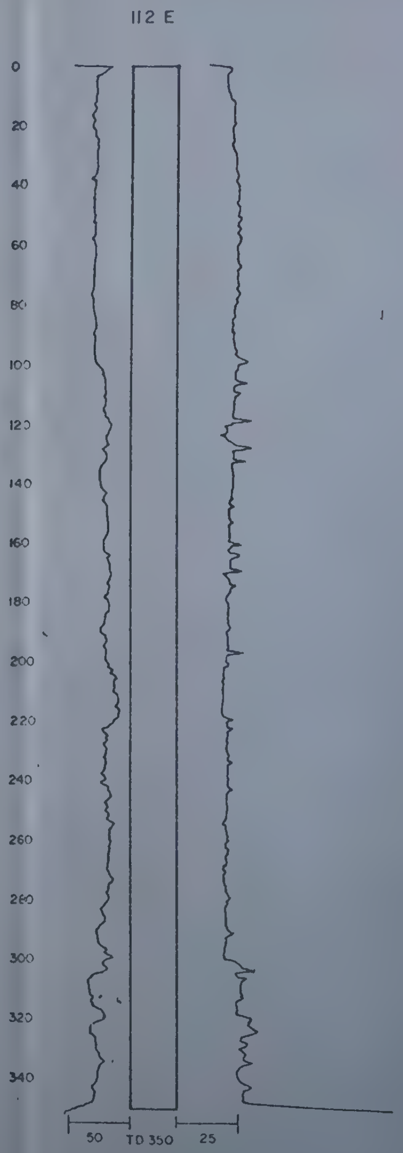
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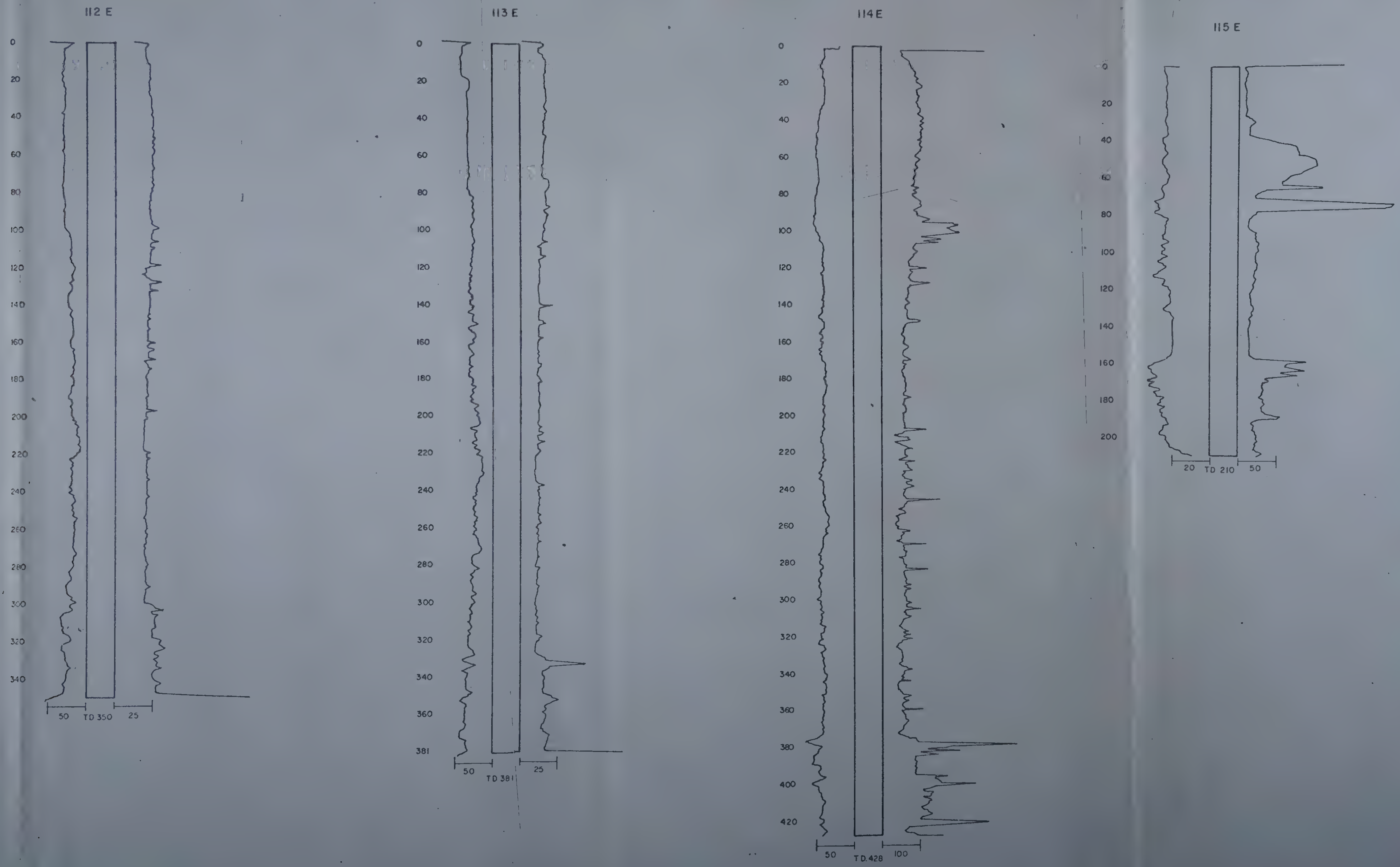

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WATER RESOURCES DIVISION

SOILS, GEOLOGY AND GROUNDWATER

BRANCH

DEEP TEST HOLES

FORT VERMILION — La CRETE REGION

1" = 50

DEC./70

FIGURE: 4

H A KERR

L D.M SADLER

GROUNDWATER SECTION

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1	A core of the Mount Head and livingstone Formation Highwood River area, Alta. By: G.L. Nielsen (Sept., 1965)
620A	Groundwater Geology of West Coleman, Alberta. By: G.L. Nielsen, (Oct., 1965)
601A	Preliminary Report, Clyde Groundwater Project, Water Resources Division. By: G.L. Nielsen (1965)
618A	Irrigation Study Basin Annual Rept. No. 1, Calendar year 1967 By: G.L. Nielsen (March, 1968)
807A	Irrigation Study Basin Annual Rept. No. 2, Calendar year 1968 By: G.L. Nielsen (March, 1969)
801A	Granum East Water Supply Study By: H.A. Kerr (April, 1968)
605A	Edson Aquifer Testing Program Edson, Alta. A.R.D.A. Project No. 28056 App. E. By: G.L. Nielsen (March, 1969)
805A	Preglacial Channel Groundwater Study, Manning, Alta. Groundwater Section (February, 1971)
812A	Irrigation Study Basin Annual Rept. No. 3, Irrigation year, 1968-69 By: G.L. Nielsen (March, 1969)
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	Field Testing of Dugouts Treated With Sodium Carbonate and Bentonite Peace River Region By: Groundwater Section (April, 1971)